USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title-Near-Surface Hydrology of the Eastern Palouse Region

Duration.

Starting date: 9/96 Ending date: 8/99

Federal Funds Requested - $142,192

Non-Federal Funds Pledged- $286,011

Principal Investigators.

Paul A. McDaniel. Soil Science Division. University of Idaho, Moscow. John E. Hamrnel, Soil Science Division, University of Idaho, Moscow.

Larry. G. King, Biological/Systems Engineering Dept.,Washington State University,

Pullman.

Congressional District- First (Idaho)

Statement of critical regional or state water problems.

Extensive areas of forested and agricultural soils in thePacific Northwest have very slowly permeable subsurface horizons that severely restrict vertical movement of water. Because the majority of precipitation is received during the winter months when evapotranspiration is low, the presence of these horizons results in formation of extensive seasonal/, perched water tables near the soil surface. In the eastern Palouse region of northern Idaho and eastern Washington. soils with perched water tables comprise -50 % of areas mapped as part of the National Cooperative Soil Survey Program (Barker, 1981). As such. perched water tables represent a significant seasonal, near-surface aquifer throughout the region. Furthermore. because of their proximity to suffaceapplied agrichemicals and their ability to promote rapid, lateral water flow, perched water tables may potentially impact surface water quality.

Despite the abundance of seasonal perched water tables in a major agricultural and forestry area such as the eastern Palouse region. relatively little is known about the manner in which these seasonal, near-surface aquifers affect recharge and surface water quality. Preliminary.' data indicate that as much as 80% of the seasonal precipitation received in this area may be present as perched water during the winter months (Gabehark 1996). This suggests that Little vertical recharge of groundwater occurs on these upland landscapes. Other data show that transport of agrichemicals may be greatly

enhanced by perched water tables. Reuter (1995) detected the presence of a Br-tracer in a perched water table 50 m downslope from, the point of application. *In* this region, nitrogen-use efficiency averages only 27 % for winter wheat production when a single, fall application of fertilizer is used (R.L. Mahler. Univ. of Idaho water quality specialist, unpublished data). At the same time, wellhead testing indicates almost one-third of the sampled wells contain NO_{3-} concentrations >2 pprn. while 5 % exceed the drinking water standard of 10 ppm (Mahler et al., 1993). Given the extent of perched water tables in this area. these studies suggest that significant quantities of nitrate may, be transported laterally from agricultural fields into surface and ground water.

Statement of results or benefit:

Seasonal perched water tables such as those in the eastern Palouse region are a common feature soils throughout the Pacific Northwest. However. relatively little research has been done to quantify and model the interaction of these perched water tables on the region's water resources. Consequently. the relationship between seasonal perched water tables and near-surface hydrology not well understood. Previous research has shown that formation of perched zones of saturation is spatially and temporally variable, and that weekly or monthly measurements widely spaced across a landscape are not adequate to fully describe the fluctuations that occur The proposed research will therefore utilize well-defined microwatersheds instrumented with automated piezometer grids to monitor seasonal water table development and determine the extent and patterns of subsurface lateral flow in sloping landscapes receiving different amounts annual precipitation.

The eastern, Palouse region of northern Idaho and eastern Washington provides an ideal setting which to study the impacts of perched water tables on water resources. First, it is a major agricultural area that receives substantial inputs of fertilizers and pesticides. Secondly, hydraulically restrictive horizons are present in most of the soils/Barker, 1981) and the landscapes -are characterized by considerable soil homogeneity, i.e. soil horizon sequences tend to be fairly uniform and continuous across hillslopes. This allows the horizons to be considered as stratigraphic units within the landscape, facilitating the hydrologic modeling effort (McSweeney et al., 1994). Thirdly, the presence of a strong climatic gradient across the region allows the study of soil/landscape units that are relatively similar (i.e. parent material, landscape setting, age) except annual precipitation. This allows the influence of climate to be directly evaluated, making the results more easily extrapolated across this and other areas throughout the Pacific Northwest where perched water tables are extensive.

By utilizing closely spaced, automated piezometer grids, we will be able to monitor the rapid response of perched water tables to climatic fluxes and determine the patterns of near-surface water movement within sloping landscapes. This approach will improve the, understanding of interactions between very slowly permeable subsoils, landscape position, and perched. zones of saturation. Monitoring data will be used in conjunction with soil hydraulic characterization dam and meteorological data to calibrate/modify existing models to the field sites. Modeling goals are to quantify subsurface lateral flow, subsurface-to-surface and return flow. vertical recharge. and agrichemical movement

within these landscapes. These parameters will allow us to model the potential impacts of perched water tables on the quality and quantityof water resources in this important agricultural region. Results will establish a basis for developing and improving technologies that optimize application rates and distribution of potential pollutants so that contamination of surface and ground and waters will be minimized.